

Space News Roundup

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National Aeronautics and Space Administration

Challenger Seven make final journey

Remains moved to Dover AFB; NASA ends SRB debris recovery effort

Remains of the *Challenger Seven* were moved Tuesday from the Kennedy Space Center to Dover Air Force Base, Delaware.

An official party, a military honor guard and astronauts escorted the remains. No official ceremony was held.

At Dover the remains will be prepared for final disposition in accordance with the wishes of the individual families. Transportation to Dover was aboard an Air Force C-141 aircraft provided by the Military Airlift Command.

Completion of *Challenger* crew cabin recovery operations was announced April 16 by Rear Admiral Richard H. Truly, NASA Associate Administrator for Space Flight.

On April 25, Truly released a statement detailing NASA's efforts to understand the probable cause of death for the crew. Examinations

by personnel from the Armed Forces Institute of Pathology have not revealed any conclusive evidence about either cause or time of death, Truly said. His statement is reprinted in full in this issue.

The effort to recover the remains and the crew cabin began on March 7 when divers assigned to the Eastern Space and Missile Center first located the crew compartment. The Navy's USS *Preserver* was dispatched to the area and began diving on March 8 and has been the primary vessel involved in the recovery operations. USS *Preserver* divers removed the majority of the crew cabin debris from the ocean floor between March 8 and April 4. Following a period of heavy seas, high winds and reduced underwater visibility, a commercial scallop boat, *Big Foot*, retrieved debris covered by silt during the foul weather.

The *Edwin Link* and the sub-

mersible *Sea Link I* conducted a visual and video scan of the area on April 7 locating debris which Coast Guard divers from the *G.W. Pierce* recovered between April 8 and April 10.

On April 12, the *Independence*, with the submersible *Deep Drone*, initiated a video survey of the area. As a result of this survey, divers from the *G.W. Pierce* and the USS *Opportune* were able to complete the recovery operations on April 18.

"This long and arduous at-sea operation, conducted under difficult conditions during both daylight and darkness, reflects great credit upon the leadership of the salvage and recovery team and particularly those individuals who were involved in the diving operation, both on the deck and below the surface. I know that I can speak for the families and all of NASA in conveying our admiration for this job well done."



Workmen unload a 4,000 pound piece of the 51-L right hand SRB at the Cape April 15. The segment, found two days before, is from the upper part of the joint where a burn through occurred. On April 28, the *Stena Workhorse* recovered the lower half of the burned through joint area. The recovery of these two components has brought to a close the deep water recovery operations for SRB debris, NASA and the Presidential Commission on the *Challenger* Accident announced April 29.

Text of Truly's April 25 statement

With the upcoming transfer of the remains of the Space Shuttle crew early next week, the time is appropriate to share with the American public the efforts which have been expended and the status of NASA's search for the probable cause of their death.

Because NASA has not been able to ascertain the cause of death of the crew, I have felt that it has been inappropriate to comment prior to this time. The determination is a very difficult and time-consuming task. Three approaches to review of the evidence are being actively pursued: examination of the remains; direct examination of the wreckage; and analysis of photography and radar to determine forces imposed on the vehicle.

I had hoped that a careful and professional examination of the remains would provide the answer.

The identification and examination of the remains was conducted by personnel from the Armed Forces Institute of Pathology. The examinations have not revealed any conclusive evidence about either cause or time of death.

Further, the wreckage examination task is complicated by the amount of damage done at water impact. Whether or not a cabin rupture occurred prior to water impact has not yet been determined by a superficial examination of the recovered components. An in-depth analysis with significant testing of the wreckage is required and is being pursued.

NASA is currently concentrating its efforts on analysis to attempt to determine the forces imposed on the cabin during and after breakup. This requires careful enhancement

of photography, review of the radar data, and significant engineering calculations. Extremely large forces were imposed on the vehicle as evidenced by the immediate break-up into many pieces. The determination of the magnitude and direction of these forces and their effect on the crew module is a lengthy process and is currently in work. Once these forces have been accurately determined, if in fact they can be, the structural analysts will attempt to estimate the effect on the structural and pressure integrity of the crew module. Once any conclusive results are obtained, the wreckage must then be examined to attempt to verify the results of the analysis.

All this work is being vigorously and carefully pursued. Its results will be reported first to the families and then to the public.

Anatomy of a project

Building an RMS mockup for the water tank proved challenging

The long-planned high fidelity remote manipulator system trainer for the Weightless Environment Training Facility (WET-F) will be going back into the water in the next few weeks amid hopes that all the bugs have been worked out.

The arm project, a large part of which has been conducted with in-house talent, has had to overcome

many challenges along the way.

It was not really the means of locomotion that was the problem, although certainly, that was tough enough. Electricity and standard hydraulics were ruled out for operations underwater, and engineers had to go to a system where distilled water acts as the hydraulic fluid.

The arm, which weighs more

than 2,000 pounds, already has been operated underwater in the Weightless Environment Training Facility, and it can be made to mimic the characteristics of the real arms, the remote manipulators built in Canada and flown on the Shuttle Orbiters.

In the final analysis, however, the real challenge to building and

operating the arm has come in designing a system that can withstand the harsh environment of chlorine-laced, chemical-ridden, basic old swimming pool water. In that sense, the WET-F has proven to be as tough an environment to design for — tougher, perhaps — than the vacuum and the merciless thermal conditions of space.

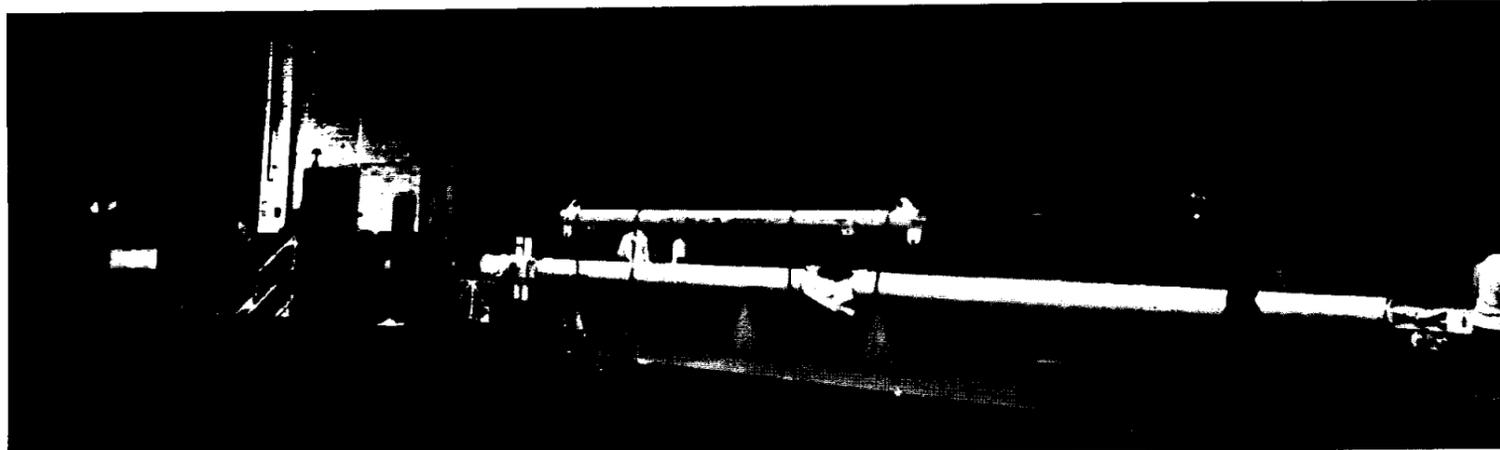
The arm, which has involved the efforts of more than 80 people at JSC, will go back into the WET-F sometime in the next few weeks. It has been in the water twice so far, once in 1984 and again in January.

It was removed from the tank in 1984 because of problems with the pins which hold it anchored at the shoulder to the underwater payload bay mockup and because of a problem with the pumping system for the distilled water. It went back into the water in January and operated for four days, but divers heard a loud pop from the shoulder joint and discovered that the water was making the graphite epoxy structure of the arms delaminate.

These setbacks are considered part and parcel of the other engineering challenges which had to be faced. The design criteria were explicit and demanding.

The arm could not be powered by electricity or hydraulics. Electrical components would require substantial maintenance, said Guy King, the project engineer. And a

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The high fidelity RMS mockup is shown here being readied for installation in the WET-F in 1984. It is scheduled to go back into the pool in May.

Anatomy of a project

(Continued from page 1)

hydraulic system, he said, would present its own set of problems. There is no such thing as a leak proof hydraulic system, he explained, and the notion of oil leaking into the pool was unacceptable. "A zero leak rate for all hydraulic systems is measured in so many CC's per hour," he said, "so standard hydraulics were out."

Weight has been another problem. The arm has to operate slowly and surely. It has to be man-rated, which requires extensive safety certification, and it has to be able to support its own weight both in and out of the water (during certain arm movements, the geometry is such that the elbow of the arm actually protrudes several feet above the surface of the water).

Because of safety reasons, load locking mechanisms, each weighing 15 pounds, had to be added. In case of a failure, the mechanisms will hold the arm in place and prevent it from toppling over into the water. Three were placed on the wrist, one on the elbow and two on the shoulder. This alone added 90 pounds to the weight of the arm, and with each new addition, the structure inexorably requires further strengthening.

"It's like a domino effect," said David S. (Stu) Grissom, who works in Integration Engineering for the Shuttle Program Office and was the first project engineer for the arm effort. "If you add weight to the wrist, then you have to strengthen the actuators and gear teeth in the elbow and the shoulder. It's no problem for the real RMS in space, but the flight version can't support its own weight on the ground. This one has to."

Jack Humphreys, who succeeded Grissom as the project engineer, remembers one example of how the tank environment forced design changes. The arm originally was to be fabricated from lightweight aluminum and graphite epoxy composites. "But that water just eats aluminum up," Humphreys said, and so engineers had to switch to stainless steel. That added weight, cost and time.

Grissom said the project has been marked by "application, at its best, of existing technology."

King, 28, a former intern and co-op student from Prairie View A&M, has been working on the project

since 1980. "This arm has already retired a couple of guys over in the shop. They keep saying it's going to retire me."

Perhaps the best example of how demanding the job has been is the following list, supplied by King, of just some of the people who have worked on the project and the areas in which they contributed:



A diver installs pins at the shoulder joint during installation in the WET-F in 1984.

In the Systems Engineering Division, Design Section, headed by Thomas Ross, the three project engineers — Grissom, Humphreys and King — were aided by Ann Bufkin, who designed the wrist joints; John Kennedy, who designed the wrist actuators and conducted extensive computer analysis; Peter Fantasia, who contributed the primary drafting support over the course of two semesters; Connie Brathwaite, who also gave two semesters of drafting support; Sharon Whitcomb, who supplied the operations manual; and Lisa Wang, who also supplied drafting support.

William C. Schneider of the Structural Mechanics Branch was consulted for repair of the delaminated composite arms, while Glenn Miller conducted solid modeling analysis of the repaired arm and Jim McMahon supplied structural analysis of the repaired arm.

In the materials area, Dan Supkis headed design, fabrication and testing of a new composite arm design, while recent retiree Ike Spiker was in charge of building the present composite arm.

Contractors for Rothe who contributed to the metal finishing and pressure testing included Bob Steiger, Hubert Price, Elizabeth Reichardt, Charlie Rieve, Dwayne Cook, Alfonso Melendez, Deborah Johnson, Wanda Steiger, Roxanne Harter, Ronald Price, Craig Stevenson, Lee Scruggs, Roland Carmen, Betty Hackworth, Linda Dean and Jeff Cook.

Joanna Wiseman of Johnson Engineering handled the job of procuring parts, while Vince Berend and Gordon House of the Safety Office approved pressure vessel and hydraulic designs.

In the Technical Services Division, Bill Whipkey, now retired, planned the shop activities in the early stages of fabrication. Jessie Adkins has been doing that since, King says, and "always in reasonable time." Tom Davis has supervised plans and schedules.

In the Assembly Machine Section under William Drummond, Larry Petty made one of the most important contributions in the building and reworking of the arm, often on weekends. Ken Easley assisted Petty building the control station and Arthur Lizza, now retired, worked on the initial assembly of the arm. Ray Petroski, also retired, built the initial control station and routed all of the plumbing through the arm. Bill Sigafoose did the electrical wiring on the new control station design.

In the Heavy Machine Section under Leon Atkins, Gilbert Cisneros built the shoulder assembly and mounting structure while Tom Hall, Ray Dunn, Walt Wilson, Henry Gomez (now retired) and Martin Prime assisted him in machining the parts.

In the Sheetmetal and Welding Section under Fred Rowell, Harold Seigfried fabricated panels for the control station while Carl Pickney built the framework. Joe Lee heat treated the sleeves used in repairing the composite arms, and Fred Winter heat treated various parts throughout the arm. Hershel Larue, Ralph Orwick and Paul Wicker were the welders on the control station.

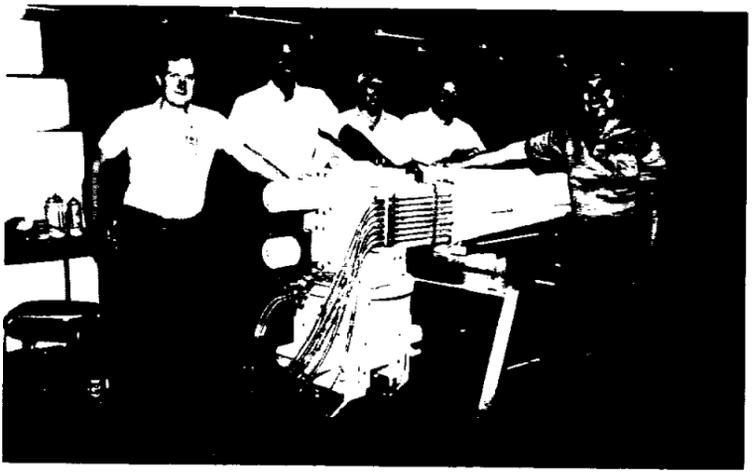
In the Model and Plastics Section under Levin Crowson, JSC's resident composite expert, J.D. Higginbotham, built the original graphite epoxy arms and supervised the rework. John Allen, Jr., and Mike McGuire assisted him. Tom Loosmore and Roger Megason also helped build the original arm sections.

In the Instrument Machine Section under Boyce Sterling, Don Petty, Larry's son, also came in on weekends to work on various parts of the job. Murray Norman and Joe Lamaites built the float can on the arm's end effector.

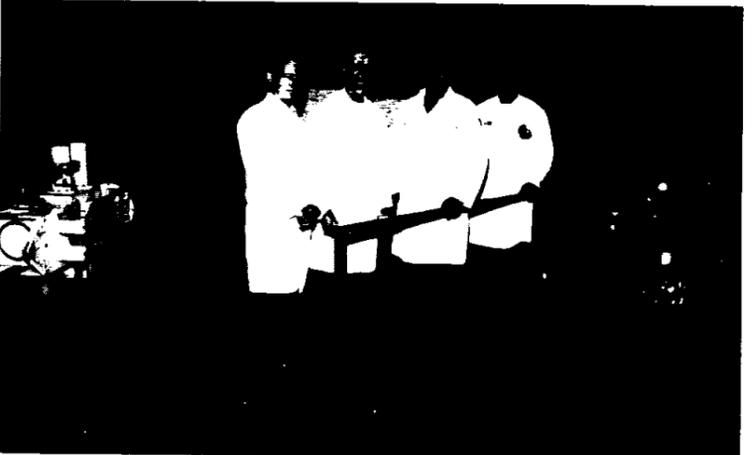
Diver/technicians in the WET-F who have worked in the installation and removal of the arm have included Sam Bishop, Dennis Shouse, Steve Kise, James Rainwater, Frank Martinez, Don Kearney, Bob Clickner, Chuck Johnson, Rudy Lopez, Mike Kalk and Gary Peters.

Boeing Safety engineers assigned to the project included O.T. Lewis, Don McGraw, Dennis McElroy and Jack Moreledge.

Finally, WET-F contractors from Northrop Services included Rusty Crawford and Val Guzman.



Shown here with the RMS simulator are, (l to r) John Kennedy, Guy King, Larry Petty, Tom Loosmore and Gilbert Cisneros.



Technicians from JSC's Technical Services Division pose with the control station for the RMS. They are, (l to r) Ken Easley, William Sigafoose, Larry Petty and Harold Seigfried.

Overmeyer to resign June 1

Astronaut Robert F. Overmeyer (Col., USMC) will leave NASA and retire from the Marine Corps effective June 1. Overmeyer has not announced his post-retirement plans.

Overmeyer piloted *Columbia* on the fifth Space Shuttle mission in November 1982 and was commander of *Challenger's* April 1985 flight, mission 51-B, the second flight of Spacelab.

Since joining NASA in September 1969, Overmeyer's duties have included engineering development of Skylab, support crew and capsule communicator (capcom) for Apollo 17, support crew and Moscow capcom for the Apollo-Soyuz Test Project, deputy chief of Johnson Space Center's Aircraft Operations

Office, deputy vehicle manager for final manufacturing of *Columbia* at Kennedy Space Center, chief T-38 chase pilot for the Approach and Landing Program, engineering development duties on the Space Station project, and member of the task force supporting the investigation of the *Challenger* accident.

Overmeyer was awarded the Meritorious Service Medal for duties as chase pilot, the Distinguished Flying Cross for STS-5 and the NASA Space Flight Medal with cluster. He has compiled more than 6,500 hours of flight in 28 different aircraft.

Overmeyer spent over 290 hours in space, including 191 orbits of the Earth and traveling more than 4.35 million miles.

Bulletin Board

ContraBand to hold concert

The 20-piece ContraBand Swing Band, comprised mostly of JSC and JSC contractor employees, will hold a dance from 8 p.m. to midnight, May 30, at the Hobby Airport Holiday Inn Atrium Hotel and Convention Center. All ticket proceeds will be donated to the *Challenger* Benefit Fund. This tribute to the *Challenger* crew is quite special to band members since 51-L Mission Specialist Ron McNair played lead tenor saxophone in the band for three years. Advance sale of the limited number of tickets is underway. The \$10 tickets are available through band members in Bldgs. 4, 17, 29, 37 and T595. Posted flyers in these buildings will direct you to a band member. For more information, call Milt Heflin at 488-5903 after 6 p.m.

PROFS to be updated in May

The Data Processing Systems Division will present a new version of PROFS, the JSC computer network system, in mid-May. Many of the new capabilities on PROFS Version 2 enhance the calendar functions. New capabilities will include the ability to copy or move one or more calendar entries to another schedule, to add lines of information to entries already on your calendar, to delete calendar entries, to add NASA holidays to your schedule, to put up to 127 lines of information on a calendar for one day, to look at several days at a time, to print a calendar locally or on system printers and to bypass calendar menus. PROFS Version 2 also will include increased tailoring capabilities. Users will be able to tailor the starting and ending times of their

work days, control how others read and write to your calendar and add the times you are available for meetings. These and a variety of other new features on PROFS will be covered in training sessions to be held during May in Bldg. 12. For information on the training course or the new features, call the Help Desk at 280-4800.

Symphony concert is May 17

Pianist Leslie Spatz, on her way to the Soviet Union to participate in the Eighth Annual Tchaikovsky International Competition in June, will be the guest artist for the Clear Lake Symphony's concert at 8 p.m. May 17 at the University of Houston-Clear Lake. Spatz is one of 20 Americans competing in the meet. She will play Tchaikovsky's "Piano Concerto No. 1." The symphony also will play the composer's "Fifth Symphony" in an all Tchaikovsky program, with Dr. Charles Johnson conducting. Tickets are \$5 or \$2.50 for senior citizens and students and are available from the Needle Shop on El Dorado Blvd., the Clear Lake Chamber of Commerce and at the UH-CL ticket window.

Apple User's Group to meet

The Bay Area Apple User's Group will hold its next monthly meeting at 7 p.m. May 12 at the Clear Lake Park Bldg. on NASA Road 1. The meeting will feature a demonstration on APPLEWORKS word processing. For more information, call 474-3373.

BAPCO to meet May 20

The Bay Area PC Organization, BAPCO, will meet May 20 at 7 p.m. at the Holiday Inn on NASA Road 1. The group is open to

all persons with an interest in microcomputers. BAPCO meets regularly on the third Tuesday of each month. For more information, call Earl Rubenstein at x3501 or Jack Calvin at 326-2983.

EAA expresses apologies

The JSC Employees Activities Association has asked the *Roundup* to pass on their apologies for any inconvenience caused during the sale of Astroworld tickets for April 4. "The overwhelming response for this event caused unforeseen problems," said Sandy Richardson of the EAA, "but fortunately, we were able to accommodate all employees who wished to participate. Thanks for your support."

Brown Bag Seminars planned

The May schedule for the JSC Astronomy Brown Bag Seminars includes a discussion of a southern expedition to view Comet Halley. The seminars are held every Wednesday from noon to 1 p.m. in Bldg. 31 Conference Room 193. On May 7, Dr. Andrew Seacord of TRW will report on the April meeting of the Division of Dynamical Astronomy of the American Astronomical Society. On May 14, Paul Maley, Gary Neals and Debby Moran will report on their expedition in search of Comet Halley. On May 21, Dr. Edgar Berring of the University of Houston will discuss plasma wave emissions from the auroral ARC of Antarctica. On May 28, a tape of the last press conference held at JPL during the Voyager II encounter with Uranus will be presented. For more information call Al Jackson of CSC at 280-2285.

Ellington BX to open

Following five months of construction, a new Base Exchange will open May 13 at Ellington Field. The BX opening is the culmination of four years of efforts to bring uniform items and other supplies to serve the Air Force employees at the Johnson Space Center and Ellington.

"At long last the BX is going to open. After many years of hard work by many people, the BX is coming to fruition," said Col. Richard Merdian, Deputy Commander for the Manned Space Flight Support Group here. "The new BX is a welcome addition as it will serve active duty military members at JSC, Ellington and in the Houston area. It will also serve military retirees in the Houston area and Air National Guard and Air Force Reserve members on duty," he added.

Construction of the facility began October 17 and was completed April 15. Since that time shelving has been installed and items are being delivered in preparation for the opening.

The \$200,000 building covers 3,000 square feet, 2,000 of which is devoted to shopping space. The BX will sell uniform items, cameras, luggage, appliances, health and beauty products, candy, beverages and many other supplies. There also will be a catalogue department to order items that cannot be stocked locally.

Current planning is for the BX to be open Tuesday through Friday from 10 a.m. to 6 p.m., Saturday from 9 a.m. to 5 p.m. and Sunday from 11 a.m. to 4 p.m. It will be closed on Mondays.

Interview

Jesse W. Moore

A look ahead with the new JSC Director

Roundup: You've been briefed lately about the operations of the Center. What are you learning?

Moore: I've learned that there's a lot of fine talent here at the Johnson Space Center. Seeing some of the things that are being done down in the labs and out in the directorate offices, meeting some of the people face to face and seeing some of the things that are actually made here and some of the capabilities here has been quite a pleasant surprise. You don't get too much of a chance to see that type of thing until you get back to the field centers. So I've been happy to meet the people and see what a range of capabilities we have here at this Center, and I've been very impressed with what I've seen down in the directorates and the divisions. What we are trying to do is go through the entire center, organizational element by organizational element, and allow each of those groups to tell me the kinds of things they are involved in, what issues they are working, how many people they have, and what things to look out for in the future. Again, the most enjoyable part of it is to meet the people and get to know them. That is one of my very highest priority objectives right now.

Roundup: When do you hope to be here full time?

Moore: We are in the process right now of trying to sell a house in northern Virginia. My wife is down here this week looking at houses in the Houston area, so just as soon as we can bring that process to some kind of reasonable conclusion, we plan to be here, probably sometime around mid to late June.

Roundup: In the meantime, what will you be doing in Washington?

Moore: I'm still working with Admiral Truly on some of the Congressional hearings and other budget cycle activities related to the operating plan for the rest of Fiscal 1986 and planning for the FY '87 budget. I am particularly interested in getting a recovery plan put together for the Shuttle and, hopefully, getting approval for a replacement Orbiter. This process will probably continue through the summer.

Roundup: Employees have probably seen stories in the papers about the deliberations of the Senior Interagency Group for Space with regard to a replacement Orbiter. Where does all that stand?

Moore: Well, the Senior Interagency Group, I think, has not formally met yet and heard the report of the working group that feeds into the Senior Interagency Group. There is what we call an "IG" group, or Interagency Group, made up of staff persons doing issue papers and trying to come to some logical conclusion about what the positions of various agencies should be as far as recovering from the *Challenger* disaster. I'm hopeful that within the next few weeks, there will be a position paper presented. That in turn will be studied in the White House. We hope to get Administration approval to then propose a supplemental to the Congress and get resources for repairs on the Solid Rocket Booster and also initiate a replacement Orbiter for *Challenger*.

Roundup: Would a new Orbiter retain the same designs as the current fleet?

Moore: I have not sat down and worked in detail that question with the people in Level 2. But my suspicion is we would try to manufacture a replacement Orbiter as close as we could to the existing fleet of Orbiters. That would allow us commonality in the checkout, commonality in the operations and so forth. That would give an economy to the program that would



be very beneficial. I know there would be a tendency to go in and make a lot of changes, but my suspicion is we will focus on making it as close as we can to the orbiters we have now. Where we have improvements underway, such as with the general purpose computers, the inertial measurement units or the auxiliary power units, we will go ahead and incorporate those into the new orbiter.

Roundup: From what you know now, will it be difficult to monitor construction of a new Orbiter, now that many people have turned their attentions to the Space Station or other elements of the Shuttle program?

Moore: I don't think that will be a problem. I think we will look at the people now in the Orbiter and GFE (Government Furnished Equipment) office today and look at our needs. After all, we will not be developing a new Orbiter, we will be manufacturing one. We'll make sure the proper talent is there to ensure we can get an efficient delivery of a new Orbiter. My expectation is we could deliver a new Orbiter within three and a half to four years. And we could fly it within about six months of the delivery date. So our objective would be to look at the task we had to do. We'll provide the adequate staffing to ensure that we get the job done. But I'm not prepared to say that we've taken too many people out of this office and put them into that office. We have a great many important things to do with the Space Station. It is a major part of this center's future, and I want to make sure that we go very strongly relative to the Space Station. Both the Level C and Level B offices are very strong. The Station program is gearing up to go into a hardware phase, and that will take a great deal of talent as well. We have to plan for both a design and hardware phase in the Station program, versus a manufacturing job for the Orbiter.

Roundup: How are we doing on the Station?

Moore: I think there is a lot of fine work going on right now. I am concerned that we make sure the program keeps on a very viable forward-looking approach. I'm frankly a little concerned about the prospects for a Fiscal '87 new start. There are a lot of pressures for resources in the nation. We are hopeful that we can get a new hardware start in the Fiscal '87 budget. It's been proposed by the President and our budgets are now going through the Congressional cycle. As far as the program goes, we are looking at our work package content. There are some issues associated with how the work

packages are split up among the NASA centers. We hope to get those issues resolved in the very near future.

Roundup: The word is that we might expect resolution of the work package issues by June or July.

Moore: Right now the plan is to try to get all the concerns of the various work package structures and any realignment that might be done resolved by about the first part of June or mid-June. I'm sure the process will be that the various centers involved in the program, and the appropriate Headquarters offices, will sit down with Dr. Fletcher when he comes on board and reach some resolution on the final alignment of the work packages. I think it is important to do it now, during Phase B, to take a look at ourselves, make sure the work is aligned properly prior to going into the hardware phase. Once we get into the Phase C/D part of the program, it is going to be very costly if we decide, 'Hey, maybe we should have done this thing differently.' What we are looking at is the Agency commitment to the program. We have said the overall program will be done for about \$8 billion in Fiscal '84 dollars. We've committed to have the Station be supported with some international partners. We've committed to have the Agency use its talents at the various centers to become somewhat revitalized in certain areas. Those are all important goals, but in terms of trying to put the best program structure together, we need to look at where we are today, and see if there are some realignments that make some sense. We may want to move some elements from one work package to another, and we may want to look at how the overall Level A and Level B interaction works. How do we get integration support to tie the elements together? It's clear we are going to have four centers involved in the program. It's clear we'll have JSC, Marshall, Goddard and Lewis doing the various pieces of the Station. What we have to be alert and sensitive to is not only our particular piece of the package from a Level C point of view, but how it's all tied together to make sure that when we launch the elements of the Space Station on the Shuttle, they can all fit together very well and we can do that within the resources and technical restraints laid upon us.

Roundup: You already sound an awful lot like a Johnson Space Center Director.

Moore: Great. Well, that's the way I want it. I am a Johnson Space Center Director and that's exactly what I intend to do, is look out for the needs of this Center and where

we are going in the future.

Roundup: The original estimate of Shuttle flights necessary to build the Station has risen. Is that going to be a problem?

Moore: Well, if we do not complement our fleet with another Orbiter, I think yes, there is going to be some concern that our STS capability is going to be somewhat limited. The deployment and supply of the Space Station is just one of the reasons why I think it is important to complement our fleet with a replacement Orbiter. If we do not get another Orbiter, I certainly don't think it will be a catastrophic blow to the Space Station. It will be of major concern to us, however. You can postulate that with three Orbiters operating in the fleet, suppose another one goes down for some reason and now you are left with two Orbiters, and so forth. That would put us in a very undesirable posture. So because of traffic and deployment demands for the Station and other programs, it is prudent to replace the *Challenger*.

Roundup: One result of the tragedy may be that the nation will go to a mixed fleet of manned and unmanned launch vehicles. If so, it will be necessary to beef up JSC's expertise in unmanned launch vehicles so as to provide a liaison between the two parts of the national launch system?

Moore: Well, the nation has already planned to go to a mixed fleet. Last year, NASA and the Department of Defense agreed that there would be a complementary ELV, or expendable launch vehicle, program. NASA and DOD agreed that in addition to the DOD use of the Shuttle at about a one-third capability, DOD would go off and develop 10 Titan 34 D-7s as complementary ELVs to the Shuttle. And the DOD would also refurbish Titan IIs for some of their payloads. The problem we find ourselves in now is that the planning had not taken place early enough, so it's going to be mid- to late 1988 before some of the Titan 34 D-7s can come on line and actually complement the Shuttle. But the principle of NASA agreeing to the mixed fleet had been agreed to previously. The issue now is, should that level of expendable launch vehicles be increased? Should there be more than 10 procured? Should the Air Force take more of the Titan IIs and refurbish them? I think there is not going to be a need for us to develop a very specialized cadre of people here to follow that program. There will be a need to be aware and see what is happening relative to the unmanned systems in the future. You know, we've been working with the Department of Defense

over the past year trying to define what the future transportation requirements of this country will be, and some of the early assessments demand that we maintain a robust STS program. Which means, in my judgement, that we maintain at least a four Orbiter fleet with adequate spares and logistics well into the 90s. It also means that the DOD would continue their Complementary Expendable Launch Vehicle program into the 90s. And at some point in the mid 1990s, we would potentially develop some type of heavy lift unmanned launch system. That would be not only for civil uses, but also for some Strategic Defense Initiative uses. Around the turn of the century, it's going to be timely, in my opinion, to begin thinking about the next generation Shuttle. We will fly the present Shuttle into the next century, and around the mid part of the 90s we should begin seriously developing the next generation. What the Johnson Space Center needs to do today, in my opinion, is to think about those technologies and those efforts we ought to be doing to get prepared for support of those future programs. One of the things that has been a criticism of our space transportation capability in this country has been the cost of getting into space. So one of the objectives of a future system should be to find ways to lower the basic cost. There are some technologies one could think about, such as new propulsion systems, new avionics systems, new operational approaches, new test and checkout methods, and the application of artificial intelligence. I think we ought to be in a position of understanding those technologies and doing some work in those areas as we approach the 1990s. The entire picture is very important to us, and we have to maintain awareness of where transportation systems are going in the future, and apply our talents to those areas.

Roundup: The country is moving ahead with work on the National Aerospace Plane, which has been designated the X-30A. Is that vehicle going to become Shuttle II, and if so, where does JSC fit into the picture?

Moore: I would not say the Aerospace Plane is the next generation Shuttle. I can't make that conclusion. I think it is good for this country to look at the next generation of aircraft, such as the Aerospace Plane, and start on the technology that would allow something like that to come into existence. What the program has done now is commit technology to carry through a research and development effort to test the viability of the concept of the Aerospace Plane. That to me does not say that it is the next generation Shuttle system. What we need to look at are the technologies important to achieving the kind of objectives that the National Aerospace Plane has set forward, like advances in structures and materials and air breathing propulsion systems. We need to apply those same technological improvements to rocket systems or chemical systems to see what kinds of gains we can realize from those areas. So no, I'm not prepared to say that the Aerospace Plane now is the next generation Shuttle. I am prepared to say that we ought to continue to support the technologies that are going to enable this country to decide what its future should be in space transportation. It may turn out that the Aerospace Plane is not a space traveling plane at this point. It may turn out to be, as the President said, a fast ride between here

(Continued on page 4)

Moore

(Continued from page 3)

and Tokyo, for example. It may not have a lot of advantages in terms of getting into space. That's why I think we should keep Shuttle II concepts and other chemical rocket system concepts in mind and develop those technologies which will allow the U.S. to evaluate what the best way is to get into space, while also meeting the objective of lowering the cost of getting to orbit. That has got to be the bottom line.

Roundup: From your vantage point, how do you see JSC recovering from the 51-L tragedy, a disaster for the Agency as a whole, but a particularly hard blow for JSC?

Moore: Well it was a terrible blow for everybody in the Agency, no question about it. But from what I am seeing in my talks with the people here, the Center has turned on a massive effort in going back and looking through the elements of the Shuttle, looking at all of the aspects of the system where there have been some concerns about this design or that design. I am very impressed with the systematic approach that Level II is taking in going through on an element by element basis to cover all aspects

of the Space Shuttle system. It will be a fairly lengthy process but it is being done in a very comprehensive and methodical manner and the Center has a lot of people tied up in that. In my judgement, that is the best thing we can do right now. While we are not flying, we can take advantage of the down time to go through and look at the critical items list and look at other areas of design concerns and see if there are ways to improve. I see a lot of activity and I see it continuing for some period of time. The other thing we are doing is responding to Admiral Truly's memo, trying to develop a bottoms up approach to the flight rate, trying to find what the appropriate timing is for the next flight. That effort is geared up and running smoothly, and I see it continuing for a fairly long time to come.

Roundup: Where are we in understanding the 51-L loss?

Moore: Well, I've been out of that pocket for about a month and really haven't gotten a late update. But from what I've read and from people I have talked to, the thinking is that we clearly know it was the joint that was the problem. I think we've all seen the piece of the right hand booster where the hot gases poured through the joint and eroded the metal. I think we know that there are a number of suspect contributors, all the way from assembly to temperatures. We will look at all of

those, I am sure, and all of the suspect contributors to the joint problem will be fixed and we will be absolutely sure of that. We will not allow the possibility of any one of those particular elements to contribute to another joint failure. The Agency, under the Marshall Space Flight Center, has set up a solid rocket booster redesign team. JSC has members on that team. There also is an oversight team which will be looking at what comes out of the SRB redesign and we have membership on that. We will stay in very close touch with what is going on to ensure that all of the elements identified as contributors to the SRB problem will be repaired. That also will allow us to get schedule information so we can know how long it will take to go in and do the necessary redesign and tests before we are ready to get back flying again.

Roundup: In a great many ways, the last few months have been very painful for NASA's people. Is there an analogy to be drawn between this period and the period following the Apollo 204 fire? Many say NASA emerged stronger from that trial.

Moore: I believe we will be a stronger agency from the tragedy we have suffered with the *Challenger* disaster and all of the agony that a lot of us here at the Center have gone through, as well as within the Agency and the country. I'm sure we are going to be stronger in

terms of technical oversight, in terms of safety focus and in terms of our overall management approaches to things. It will make us a better agency. It will bond us together. The worst thing that could happen following a tragedy like this is that we would not be keenly aware of the kind of events that led up to the accident and the circumstances that followed the accident. If you don't learn from that, you can't take that experience and turn it around into something positive. We must learn from this and make sure nothing like it happens in the future. We must do everything we possibly can to prevent that.

Roundup: When will we fly again?

Moore: I have said anywhere from 9 to 18 months, and my judgement now is that it will be closer to 18 months. But again, I think that will be really determined by what the SRB redesign team comes up with, plus any other factors we may cover during our comprehensive review. My intuitive feeling now is that it will be closer to 18 months.

Roundup: What goals do you have for your directorship here? What do you hope to accomplish?

Moore: What I really want to accomplish here is to get the Shuttle back into a very positive framework in the minds of the people here at the Center and within the minds of people in the Agency and the country. I want to see us get on with a very strong and viable

Space Station program. At the same time, I want to keep this center on a course of technical excellence. I want to keep the Center identified with the development of critical technologies necessary for the future of this country. There are some very talented people here that we can look to in making sure that we have a very strong institutional base. I want to make sure that I hear the words of the center. I want to ensure that there is an avenue for me to relate to the people here at JSC. The center is no better than its ability to promote communication among its people, in my opinion. It is made up of people, and I want to make sure that during my directorship, we have a good flow of communication among them. I want to understand their needs and want them to understand mine and my sense of direction, so that we can all share together a sense of where we are going in the future. I personally believe we have a very bright future here. We have a strong base of talent and two of the most exciting programs in the United States aerospace effort. We are going to do our best to make sure those programs succeed and that we can continue to build for the future. We will be a part of the technologies that will put us in a pivotal position for manned space flight efforts in the 1990s and on into the 21st Century.

Roundup Swap Shop

All Swap Shop ads must be submitted on a JSC Form 1452. The forms may be obtained from the Forms Office. Deadline for submitting ads is 5 p.m. the first Wednesday after the date of publication. Send ads to Roundup, AP3, or deliver them to the Newsroom, Bldg. 2 Annex, Room 147. No phone in ads will be taken.

Property & Rentals

Lease: Baywind II condo, 1 BR, FPL, appliances, W/D connections. Jim Wiltz, x5437 or 944-0451.

Sale: Burnet Co. land, 40 mi. NW of Austin, hunting, views, fenced, must sell, \$1,995/acre, neg. Bullock, 335-1262.

Sale: 2 BR house 2 mi. north of Texas A&M, adjoining trailer lot, or both for \$53,000. Larry K., x4614 or 946-4059.

Sale: 100 acre ranch, Marlin area, bldgs., utilities, trees, ponds, tractor, equipment, \$775/acre, owner finance. (817) 896-3863.

Sale: 3-2-2, new, on 1 acre in Galveston county, save and buy from owner-builder, \$69,500. 337-2680.

Rent: Galveston-by-the-Sea luxury condo, completely furnished, 2 BR, sleeps 6 max., 2-day minimum, or by week, month or year. Jay Clements, 474-2622.

Sale: 420 acres 1 mi. out of Center, TX, 3000 timber, 120 pasture, 1/2 minerals. Billie, 482-4365.

Sale: 1/2 acre lot, 1.5 mi. from JSC main gate, all utilities, trees, level, \$23,500 neg., owner finance part. Art, 486-1350.

Sale: Inverness at Walden timeshare red week 37, '86 week space-banked w/RCI, 3 yrs. RCI dues paid, '86 maintenance fee paid, assume at \$162.20/mo. Mac, x2013 or 488-3976.

Sale: 30 acres 15 mi. north of Lufkin, fronts on all weather road, creek, water and elec. avail., all wooded, gently rolling, priced to sell. 488-7238.

Sale: 9 wooded acres 16 mi. north of Lufkin, hardwood trees and creek. 488-7238.

Sale: 3-2 mobile home, FPL, wet bar, fenced, 10 x 16 screened patio, corner lot. 559-2925.

Lease: CLC University Green 2-2.5-2, townhouse, W/D, refrig., near pool, ex. cond., \$650/mo. 488-1036.

Lease: Heritage Park 3-2-2, new section, formal dining, fenced, new paint in and out, FPL, high ceiling, large kitchen, \$575/mo. 482-6609.

Lease: Friendswood/Forest Bend 3-2-2, fenced, patio, front porch, \$495/mo. 482-6609.

Sale: 2-2-3 on 4.25 heavily wooded acres near Hardin, \$39,000. 944-5624.

Lease: Egret Bay 1-1-2, FPL, water view, W/D, lots of closet space, \$350/mo. Actkinson, x3781 or 482-7061.

Rent: Bolivar beach house, 2 BR, AC, large deck, 6 mi. from ferry, 3 blks. to beach, easy access to Bay, \$200/wkend., \$500/wk. Garland, 333-3114.

Sale: Friendswood 1 acre lot, 8 mi. to NASA, all util. avail., \$30,000. Denais, x2783 or 481-0046.

Cars & Trucks

'77 Buick LeSabre, 2 dr., AC, good cond., recent tuneup, \$1,200 firm. Goodwin, x3582.

'74 260Z, looks and runs good, \$1,750. 488-3293.

'68 Mustang, red, auto, rebuilt 289, new trans, Cragars, Holley, good in-

terior, many new parts, steering needs work, \$2,800 OBO. 486-8618.

'79 VW Rabbit, new tires, brakes/waterpump in ex. shape, \$1,400 OBO. Jon, x3762 or 532-1114.

'79 Pontiac Sunbird, 4 spd., 4 cyl., AC, PS, 55K mi., radials, AM/FM, \$1,750. Richard, x6226 or 488-3314.

'76 Ford LTD, 4 dr., 138K mi., new engine parts, good running cond., \$1,200. Rod, x4161 or 486-8183.

'83 Toyota 2 dr. sedan, 46K mi., very clean, PS, auto/overdrive, stereo, tach, asking \$6,400. 333-2717.

'79 Ford Futura, AC, PS, PB, stereo, 70K mi., 6 cyl., good tires, \$1,800. 482-1702.

'82 Mazda RX7 GSL, auto, leather inter., ex. cond., 30K mi. Moser, 474-2060 or Ginger, x6511.

'77 Chevy Monte Carlo, ex. cond., 1 owner, \$1,500 OBO. 488-7910.

'84 Camaro Z28, 5.0 HO, red/beige, fully loaded, T top, ex. cond. Mike, 266-5511.

'78 Fiat Spyder convertible, 5 spd., new tires, AM/FM, 83K mi., \$1,400. Marlon, x3921 or 488-6801.

'80 Cadillac Coupe de Ville d'Elegance, fully equipped, ex. cond., 68K mi., \$5,500. 326-3370.

'81 Pontiac Firebird, V-6, AT, PS, PB, AC, AM/FM/tape, tilt, very clean, runs and looks sharp, \$2,750. McNeely, x6347 or 482-5837.

'72 Pontiac Ventura II, 117K mi., good cond., one owner, \$400. 481-8107.

'76 Pontiac Grand Prix, 1/2 vinyl, PS PB, tilt, AC, AM/FM, 2 bbl., 350 V8, auto, buckets, console, excel., \$1,400. 333-2395.

'85 Pontiac Grand Prix Brougham, fully loaded, 12,500 miles, silver gray. Don, 280-2450 or 486-1830.

'76 VW Scirocco, very clean in and out, good work car, \$1,200 OBO. 554-2210.

'77 Malibu Classic, V8, 74K mi., AC doesn't work, otherwise good cond. Betty, x2811.

'84 Ford Cargovan, 29K mi., 302 OD, AC, PWR, dual tanks, LWB, super clean, NADA loan value. Dennis, x4081 or 532-1222.

'78 Chevy Van, low miles, nice in, rough out, best offer. David, x3255 or 488-5259.

'76 VW Beetle convertible, bright orange, black top, ex. cond., 60K mi., \$3,895. 334-3896.

'81 Plymouth Reliant K, 2.2 liter, 4 spd., 27 MPG, super AC, 64K mi., extremely clean, \$2,595. 334-3896.

'78 Caprice, AC, PB, PS, cruise, 4 dr., AM/FM, \$1,550. 482-3011.

'82 Ford Fairmont, 4 dr., AC, PB, PS, clean, \$2,350. 482-3011.

'79 Monte Carlo, auto, AC, PS, PB, PW, AM/FM/cassette, cruise, tilt, buckets, 55K mi., ex. cond., \$2,300. Jackson, x4406 or 337-6641.

'79 Datsun 310GX, AC, new tires/paint, 72K mi., \$2,200 OBO. 482-2405.

'72 Capri, good engine, AC, rusted, good tires, 4 spd. Charles, 280-2284 or 482-6539.

Recreational

'71 Winnebago, self-contained, Onan generator, roof air, sleeps 6, 318 cu. in., Dodge chassis, tape, cruise, tach, etc., very good cond., \$5,250. 488-8105.

'80 Southwind 25' motor home, fully self-contained, dash and roof air, 36K mi., new paint, very good cond., \$22,000. 480-8252.

Bethany camper, pop up, little use, good cond. Charles, 280-2284 or 482-6539.

Cycles

'84 Honda CR250, ex. cond., must sell, \$1,150. Bullock, 335-1262.

20" Super Mongoose BMX bike, top quality, chromemoly steel frame, like new, cost over \$300, sacrifice at \$150 OBO. McNeely, x6347 or 482-5837.

'85 Honda CR125, ex. cond., best offer over \$1,000. 554-4315.

'82 Honda Aero 80, red and black, ex. cond., \$425. Brenda, x2831 or 334-4608.

'70 Suzuki T125, low miles, good cond., needs some work, manual included. Mark, x5056 or 334-6681.

'71 Honda Trail 70, ex. cond., kept garaged, less than 500 mi., runs great, climbs anything. Mark, x5056 or 334-6681.

'83 Kawasaki KZ 550 Spectre, 4 cyl., shaft, ex. cond., low mi., \$1,000. Chuck, x5803 or 482-1569.

'83 Honda Aero 80, \$120. Samouce, x2225 or 482-0702.

Boats & Planes

'82 25 HP Evinrude outboard motor, 15 hrs., \$900. 534-6443.

'79 Falcon Malibu, 23 ft. of pure offshore fishing machine, 235 HP Evinrude, many extras, radio, etc., clean and well maintained. Morgan, x3475 or 487-8018.

'77 Baja jet boat, custom trailer, 454 cu. in. Chevy engine, Berkley pump, needs work, \$1,000 OBO. Horton, x4084.

15' MFG tri-hull w/70HP Evinrude, trailer, '71 hull and '77 motor, new carpet, battery and seats, accessories, \$1,400. Merrifield, x5753 or 554-2486.

Experimental Q2 airplane, 200TT, 64 HP, 140 cruise, 2-seat, tri-gear. Wood, x4626.

Audiovisual & Computers

JVC-GNX video camera, char. gen., lens hood, 2 filters and case, \$800; JVC omni/uni mike, \$75. Underhill, x2138 or 326-1303.

TRS 80 Mod 4, 128K, 5 meg HD, DMT400 printer w/stand, modem print controller, software, \$2,000 OBO. 331-1600.

Want to buy Radio Shack color computer I, in gray case, w/any memory size, will pay \$135 or will trade new 64K color computer II. Doc Pepper, 282-3130.

TEAC 10 band audio equalizer, perfect cond., \$50. Musgrove, x3566 or 488-3966.

Will trade RS color computer system and software for audio signal processing equipment. Dick Snider, x5291 or 332-3280.

Sony TC-630 portable reel-to-reel tape deck, sound on sound, echo, 3 head, solid state, \$300. Overlander, 486-1332.

Heathkit 25" color TV, working cond., tabour door cabinet, all manuals, other set for spare parts, \$100. 482-2369.

Apple Hi-Res green phosphor monitor, 1.5 yrs. old, original box and documentation, perfect cond., \$80. Jeff DeTroye, x5378.

Birdview satellite system, 8.5' perforated dish, block converter, drive, receiver, 100' cable, hand held remote, 4 wks. old, still under warranty, \$2,000 OBO. 554-6695.

Canon 300/F4, lens w/case, ex. cond., \$250. 488-4521.

Household

Apartment full of furniture and misc., everything goes. Joan, x3057 or 486-1058.

Double bed, mattress and box springs in ex. cond., 9-drawer dresser. Theresa, x4048 or 538-4198.

Small 4-drawer chest, good cond., nice for child, \$10. 488-6521.

Antique 4 drawer solid maple file cabinet, turn of the century, ex. cond., original brass, recessed side panels, solid wood backstops on brass rails, \$800. Brian, x5111 or 480-5194.

New/unused heavy duty king/queen bed frame on rollers, \$45. 772-0452.

Admiral dishwasher, top of line, cutting board top, convert. to built-in; 6 dining chairs, almost new, \$100; Sears electric lawn mower, \$90. Will, x4528 or 585-8953.

Stearns & Foster king size box springs

and frame, \$75 OBO. 482-5681.

Maple bedroom suite, twin bed, chest and vanity w/mirror and bench. Barbara, x6327.

Matching sofa-bed and chair set, good cond., great starter. \$60. Joe, x6327.

Medium pile carpet with padding; tan color includes 8 x 12, \$50, 12 x 6, \$125; light blue includes 12 x 12, \$100; approx. total 57 sq. yds., ex. cond., separate or \$300 for all. Steve, 335-1070.

Dehumidifier, ex. cond., \$75. Joe, x6327.

Pets

AKC reg. German Shepherd pups, black w/silver and tan, born Feb. 11. Billie, x4105 or 482-4365.

Free kittens, black and black/white, born April 1, ready May 13. Brian, x5111 or 480-5194.

Miscellaneous

Yamaha 2.6 KV generator, \$350. 554-4315.

Free wood, mostly pine, cut, not split. Samouce, x2255 or 482-0702.

7 ft. pool table, auto ball return, 5 cues, wall rack, \$350. Roxanna, x5362.

Pickup cover for LWB Toyota, insulated, paneled, \$300; original tires/wheels for Toyota PU, 14K mi., \$75. Underhill, x2138 or 326-1303.

Will sell or trade U.S. revenues and back of book stamps, including wine stamps and officials. Doc Pepper, 282-3130.

Hurricane twin fin surfboard, 5'5", ex. cond. David, 488-3966.

Balanced batons, good cond., reasonable, several sizes. 488-6521.

Sears Craftsman 9" table saw, stand, ex. cond., \$150. Kevin, x4605.

Gilruth Center News

Call x3594 for more information

Garage sale — Come shop around at the Rec Center's annual garage sale. All types of items will be on sale from 9 a.m. to 3 p.m. May 17. Tables are \$2 per person. Reservations must be made in advance and there is limited space.

Beginning shorthand — This course will cover the basics of reading and writing Gregg shorthand. The 6-week course begins May 14 and meets from 5:30 to 8:30 p.m. The cost is \$85 per person. Bring a pen and shorthand book to the first class.

Dancercise — Part dance and part exercise, this class works on toning and will meet for 6 weeks beginning May 20. The class meets Tuesdays and Thursdays from 5:15 to 6:15 p.m. at a cost of \$25 per person.

Ladies weight training — This popular course begins May 12 and runs for 4 weeks. The class meets Mondays and Wednesdays from 7 to 8 p.m. The cost is \$20 per person.

Word processing — Work with a variety of word processors in this class, which will cover Word Star and teach you how to do legal letters, resumes and other documents. The 6-week course begins May 29 and meets from 5:30 to 8:30 p.m. The cost is \$190 per person.

Defensive driving — Learn to drive safely and qualify for a 10% reduction in your auto insurance for the next three years. This all day Saturday class meets from 8 a.m. to 5 p.m. May 17. Space is limited.